with plaster of Paris, at the same time supplying them with sufficient moisture. The roots were placed at an angle of 45° with the axis, as were PICCARD'S. While PICCARD used 20–40 rotations per second, HABERLANDT found it necessary to use only 5–20.

If the tips of the roots extended 1.5^{mm} or more beyond the axis, they always bent in the direction according with the irritability of the tip; if 1^{mm} or less, the curvature was determined by the irritability of the growing zone. HABERLANDT points out (what he says PICCARD and his critics have failed to notice) that where the root tip extends 1.5^{mm} beyond the axis, the growing zone receives on the average greater stimulation than the root tip, the centrifugal acceleration of the growing region, by reason of its greater length, being 2.8–3.9 times that of the tip. This, of course, is due to the considerable length of the growing zone. HABERLANDT never gets the S curve described by PICCARD. He concludes that 1.5–2^{mm} of the root tip, in the forms worked with, is very sensitive to gravity and to centrifugal acceleration. The growing zone is likewise sensitive, but far less so than the tip. The marked geotropic sensitiveness of the tip corresponds to the well-developed statolith apparatus of the cap, while the slighter sensitiveness of the growing zone is due to the rather poorly developed statolith starch of the periblem in that zone.

He finds that the geotropic irritability of the growing zone is manifested with acclerations as low as 0.25 gravity, and therefore that it comes into play in ordinary geotropic response, exactly opposite to NĚMEC'S conclusion.

HABERLANDT also conducted a set of decapitation experiments, making full allowance for the shock effect of decapitation, which accord fully with the results by the PICCARD method. He concludes that all these results are quite in harmony with the statolith theory.—WM. CROCKER.

Plant proteases.—VINES has now for more than ten years devoted his attention to the proteases of plants and he has made the field practically his own. The conclusions he has from time to time announced mark periods in the development of the problem. The last paper by this author[29] should be considered in two parts, the first of which deals with his latest results, while the second constitutes a review of the earlier investigations, together with final conclusions.

The papain or papayotin of the latex of papaw, which has long been known to digest proteins, was shown by MARTIN to be both peptic and peptolytic. It was therefore designated a tryptic enzyme. The discovery that other vegetable extracts (germinated lupin, castor-bean, some fruit juices, malt, yeast) had a like action, led to the notion that plant proteases in general are tryptic. This conception, although a generalization from too limited data, was an advance, as it supplanted the prevalent idea (also resting upon an insecure foundation) that plant proteases are peptic. Following up his work on tryptic extracts from various sources, VINES has finally come to believe that the proteases of plants are of two sorts, the peptases and the ereptases. This conviction has been further fixed

[29] VINES, S. H., The proteases of plants. VI. Annals of Botany **23**:1–18. 1909.

by his latest results, which are that from papayotin both peptase and ereptase may be obtained. The former is soluble in dilute NaCl and little soluble in distilled water, while the latter is easily soluble in pure water. That the demonstration of these two proteases in papayotin might be more complete is admitted by the author. Similarly, preparations from both fresh and dry yeast show the presence of peptase and ereptase.

The proposal of VINES, after reviewing the subject, to supplant the "vegetable trypsin" idea by the conclusion that the proteases of plants belong to two main groups, the peptases and the ereptases, and his further classification of the former into endopeptases and ectopeptases, appeal to the reviewer as unnecessary and unwarranted, inasmuch as the new may prove to be as incomprehensive as was the "trypsin" idea. Further, if a name must be given to something of which little is known, that name should have some reference to the qualities marking individuality, rather than to the mere incident of its occurrence. So far, the "ectopeptase" is confined to Nepenthes. The anticipation of the author that "ectopeptase" is of wide occurrence may be justified, but in one case, namely, the pitcher-liquid of Sarracenia, peptic action has not been found.[30]—RAYMOND H. POND.

Morphology of Pseudotsuga.—The investigation of the North American representative of this interesting genus by LAWSON[31] has filled a gap in our knowledge. In general it conforms to the well-known characters of Abietineae, but it presents some interesting peculiarities. The pollen grains are wingless, and the mechanism for receiving them is most unusual. There is a stricture of the integument above the nucellus, which results in two distinct micropylar chambers. The outer chamber is partially inclosed by the infolding tip of the integument, from whose inner face numerous hairlike processes are developed as outgrowths from the epidermal cells. Within this chamber the pollen grains are received and germinate, a tangle of tubes passing down through the inner chamber to the nucellus.

At the time of pollination (April–May in California) the pollen grain contains the two disorganized prothallial cells and the generative and tube nuclei. Just before tube-formation the generative cell divides to form the stalk and body cells, both with distinct membranes, but soon becoming very unequal. Before the tip of the nucellus is reached by the tube, the nucleus of the body cell divides to form two unequal male nuclei. Fertilization takes place within 60 days after pollination, and the entire nuclear contents of the tube are discharged into the egg.

The functioning megaspore is surrounded by a distinct tapetal zone, and the magaspore membrane becomes conspicuous. The development of the female

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[30] ROBINSON, WINIFRED J., A study of the digestive power of *Sarracenia purpurea*. Torreya **8**:181–194. 1908.

[31] LAWSON, A. A., The gametophytes and embryo of *Pseudotsuga Douglasii*. Annals of Botany **23**:163–180. *pls. 12–14*. 1909.